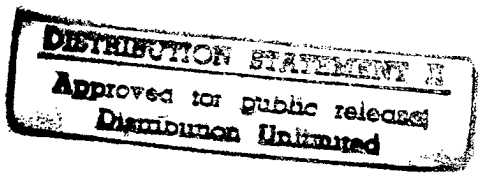
JPRS-JST-92-030
28 OCTOBER 1992

JPRS Report



Science & Technology

Japan

PRESENT STATUS OF NUCLEAR ENERGY DEVELOPMENT AND UTILIZATION IN JAPAN 1992

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SCIENCE & TECHNOLOGY

JAPAN

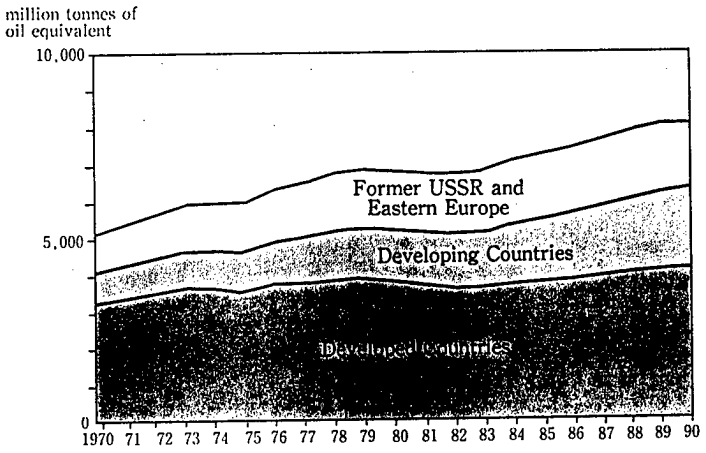
PRESENT STATUS OF NUCLEAR ENERGY DEVELOPMENT AND UTILIZATION IN JAPAN 1992

43070001E Tokyo SCIENCE AND TECHNOLOGY AGENCY in English [date not given]
pp 1-28

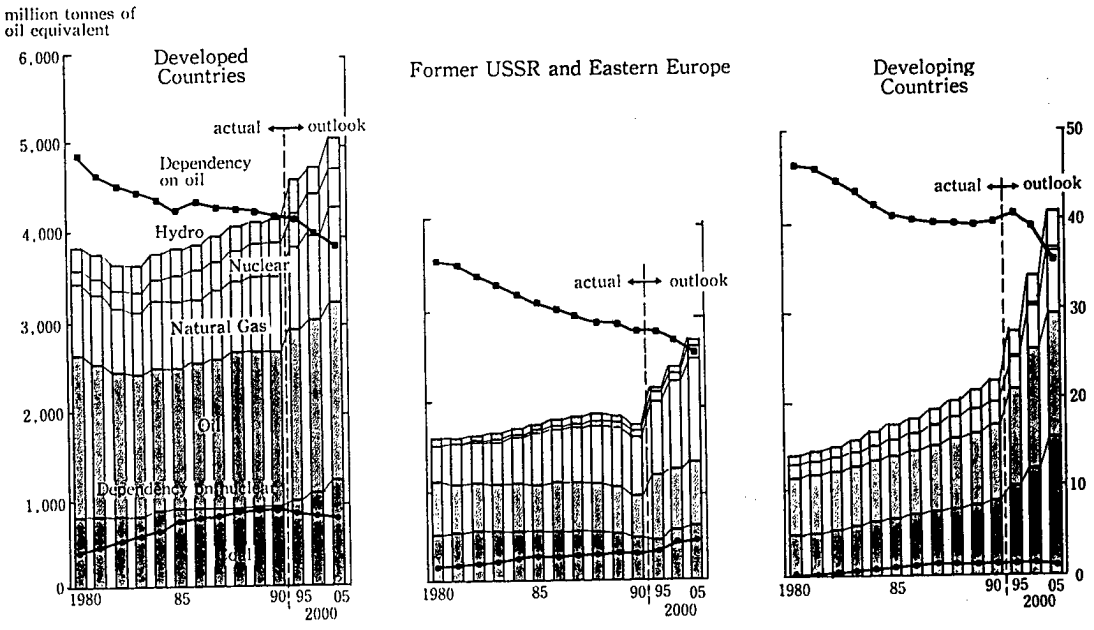
CONTENTS

I . Position of Nuclear Energy Development and Utilization in Japan

While worldwide energy demand is expected to grow steadily, mainly in developing countries, there is a global concern over the tighter supply/demand situation of oil, which is the main source of energy today, due to the instability of its supply. Further, oil, as a valuable resource with limited reserves, must be preserved for the developing countries and also for succeeding generations; thus, it becomes more and more important to suppress its consumption as a source of energy.



Souce : BP STATISTICAL REVIEW OF WORLD ENERGY

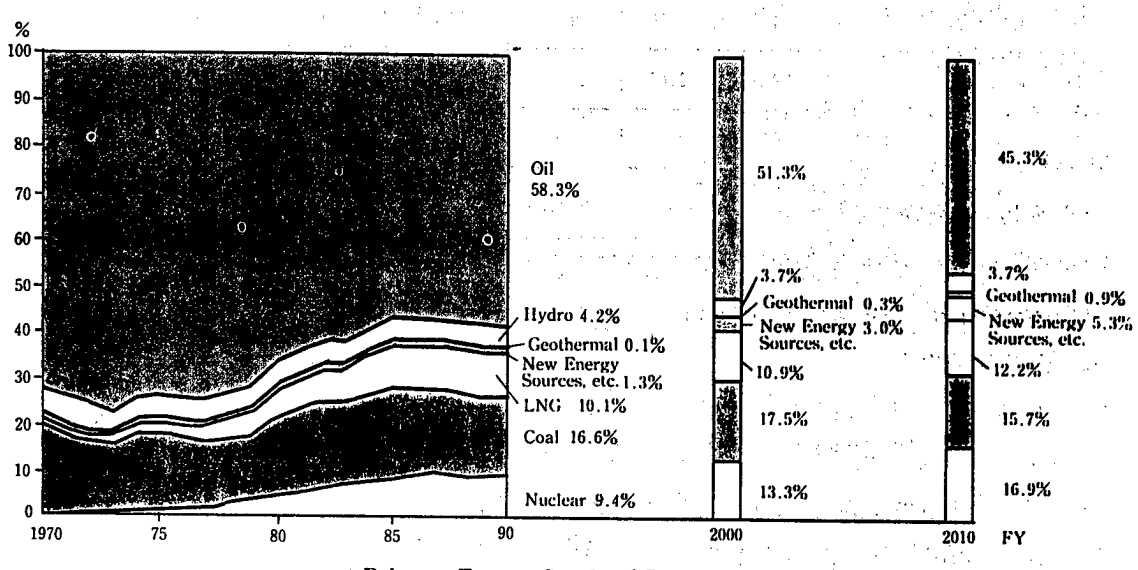


World Energy Requirements

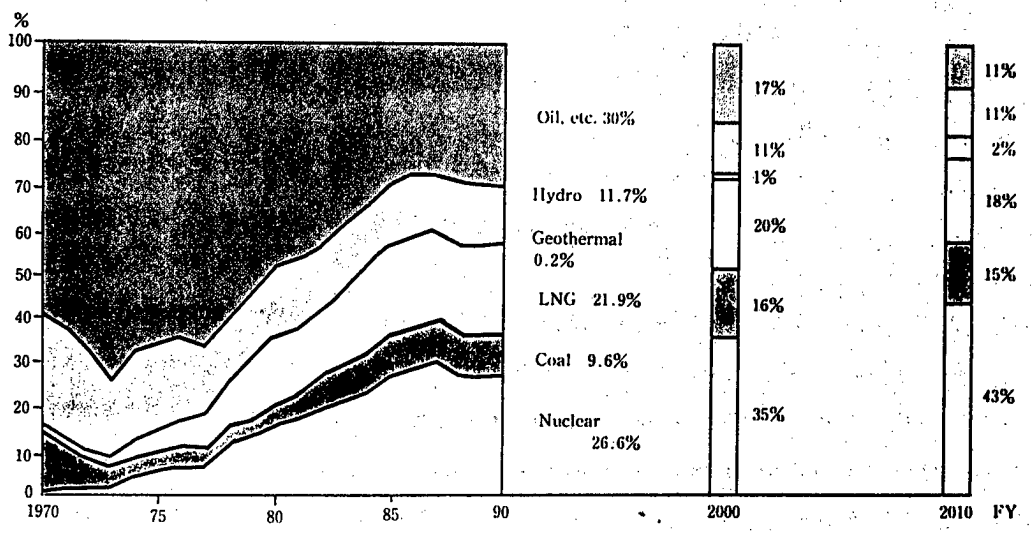
Souce : BP STATISTICAL REVIEW OF WORLD ENERGY
IEA ENERGY AND OIL OUTLOOK TO 2005

Moreover, with respect to global environmental problem such as the global warming effect, a forward-looking response is indispensable from the standpoint of energy policies.

In Japan, efforts have been made to develop and introduce alternative sources of energy to oil, but compared with other major developed countries, the weakness in Japan's energy supply structure is rather significant. At the same time, energy demand has been growing vastly in recent years, and further increases are expected.



Primary Energy Supply of Japan



Total Power Generated of Japan Source : Statistics of MITI

Energy Demand Outlook (Final Energy Consumption) (October, 1990)

(Unit : 100Million kl crude oil equivalent)

Item \ Fiscal year	FY1989 (actual)	Percentage	FY2000	Percentage	Average annual growth rate(%) ('89-'00)	FY2010	Percentage	Average annual growth rate(%) ('00-'10)
Industry	1.78	% 52.8	1.93	% 49.5	0.7	2.06	% 47.6	0.7
Manufacturing Indutry	1.51	44.8	1.64	41.8	0.9	1.73	39.9	0.6
Household-service	0.82	24.3	1.10	28.1	2.7	1.34	30.9	2.0
Transportation	0.77	22.9	0.87	22.4	1.1	0.93	21.5	0.7
Total	3.36	100	3.91	100	1.4	4.34	100	1.1

(Notes) 1. The industry sector includes primary and secondary industries excluding energy industries such as coal mining, petroleum mining, natural gas mining, petroleum refineries, coke producers, etc. (It excludes the management sector and self-transportation).
2. The household-service sector includes the management sector, tertiary industry, (excluding power utilities, town gas utilities, commercial transportation) and the household sector. (It excludes self-transportation).
3. The transportation sector includes commercial transportation and self-transportation of the industry and household-service sector.
4. Non-energy uses, e.g. raw material for petrochemistry, are included in the industry sector.
5. Conversion to oil equivalent is based on a thermal value of 9,250 kcal/liter.

Under these circumstances, in order to realize a stable energy supply and stable economic development while conserving global environment, future energy policies must consider the establishment of an optimum combination (best mix) of energy by fully utilizing the characteristics of each source of energy available with full consideration given to energy supply stability, economic performance and environmental effect. These policies will be achieved through: (1) promotion of energy conservation, (2) continued reduction of dependency on oil, and (3) enhanced generation by non-fossil energy sources (such as nuclear energy, new energy, etc.) among the various alternatives.

Among those, the need for further continued efforts toward energy conservation are very important, particularly since even if considerable conservation is achieved, energy demand in Japan is expected to increase in the future.

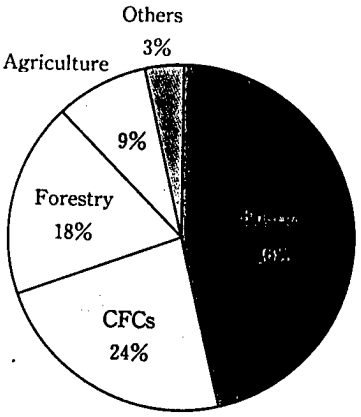
The potential of new energy sources such as solar and wind power is enormous, and they offer additional advantages in terms of environmental effect. Research and development in this area is thus being actively pursued in the hope of introducing such sources to the maximum degree, but many problems still remain in regard to quantity, supply stability and economic performance. So quick and large-scale introduction of new energy sources are not yet possible today, they will likely play a supplemental role in the near future.

Nuclear power, on the other hand, is a stable source of energy, as uranium resources are widely distributed throughout the world in comparison with the other resources and the fuel supply stability is quite high. Also, it can be regarded in Japan as a quasi-indigenous source of energy by the establishment of nuclear fuel cycle. Moreover, nuclear power has higher economic performance in comparison with the other power-generating sources, and offers higher stability of price over the long term. All these features indicate the further economic superiority of nuclear power.

Moreover, nuclear power generation provides an excellent energy balance and discharges no carbon dioxide or nitrogen oxide in the generation process. Also, carbon dioxide emission from nuclear power including the fuel production process is very low compared with other methods of power generation. This is the reason nuclear power is expected to play an important role in solving global environmental problems including the global warming effect. This fact has already been confirmed internationally, in the London Summit's Economic Declaration in July 1991, and in the Joint Declaration on Nuclear Power by the four countries of Belgium, France, Germany and the U.K. in March 1991.

Domestically, the Action Plan for Preventing Global Warming (formulated in October 1990) prescribes promotion of the development and utilization of safe nuclear power as a prerequisite, in which nuclear power is positioned as an energy source that discharges no carbon dioxide.

Therefore, in establishing the best mix of sources of energy in Japan, and in achieving Japan's global responsibility by adopting measures for worldwide energy stability and contributing to the solution of environmental problems, nuclear power, which has excellent supply stability, high economic performance and environmental friendliness, should play the central role as a main source of energy in Japan. And for these purposes nuclear development and utilization should be promoted positively with every effort for safety.



Estimate Contribution of Human Activities to Global Warming Effect from 1980 to 1990

Also, as mentioned above, nuclear power can be positioned as a quasi-indigenous source of energy because its supply stability can be enhanced through the establishment of nuclear fuel cycle. Thus, it further contributes to the formation of a recycling-oriented society through conservation and recycling resources.

High technology enables nuclear power to generate energy. So its fuel supply stability and economic performance are determined mainly by technology itself rather than external factors. Thus, technology can strengthen the status of nuclear energy as a reliable energy source. From these viewpoints, the significance of promoting the development and utilization of nuclear power is considerable for Japan which is seeking to establish a state established on science and technology.

On the other hand, the development and utilization of nuclear energy is being carried out on the basis that all possible measures for ensuring safety are taken. As stated above, nuclear power is an indispensable energy source in Japan. Recently, however, it tends to take several years to find a new site for a nuclear power plant. To promote the steady development and utilization of nuclear energy in the future, then, it is important to make every effort to guarantee safety, while at the same time facilitating siting through gaining public understanding and cooperation.

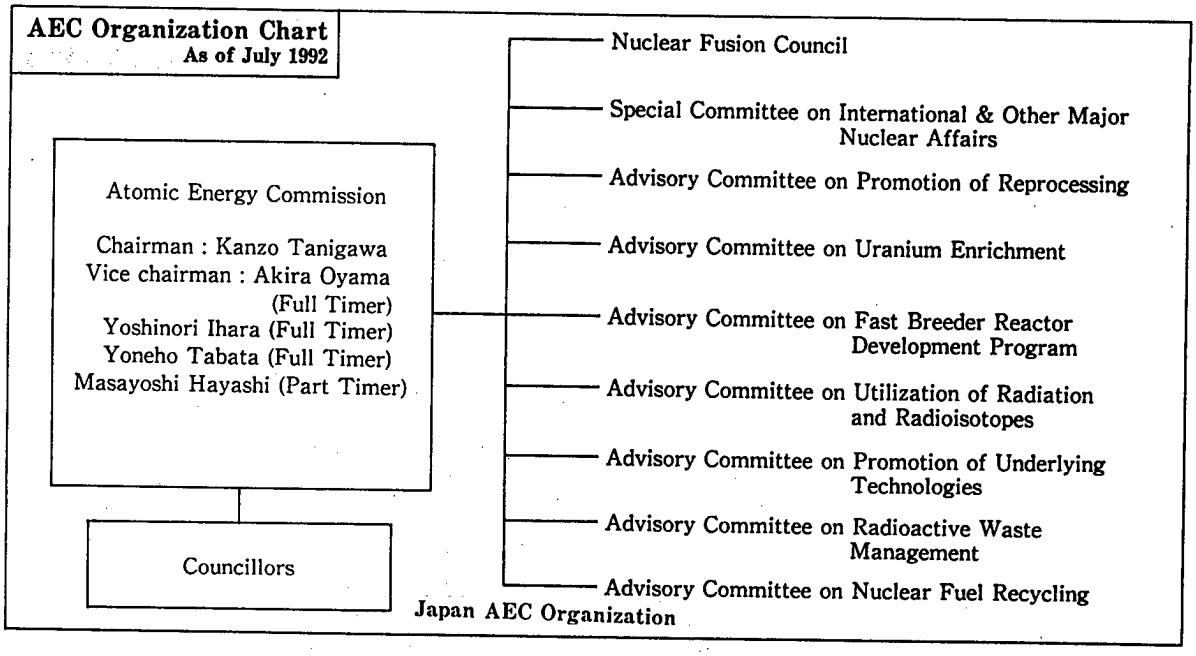
Moreover, it is Japan's national policy to carry out development and utilization of nuclear power for peaceful purposes only. So Japan will continue to maintain a clear stance on this policy so as not to induce international concern over nuclear non-proliferation issues. Japan will also contribute to the trustworthy development of International Atomic Energy Agency (IAEA) safeguards and to strengthening the world's nuclear non-proliferation regime as its international responsibility in promoting the peaceful utilization of nuclear power.

II. Japan's Organization for Development and Utilization of Nuclear Energy

Development and utilization of nuclear energy in Japan are being carried out in accordance with the Atomic Energy Basic Law, which stipulates peaceful purposes only, secured safety, independent operation under democratic management, internationally open access to all achievements, and promotion of international cooperation.

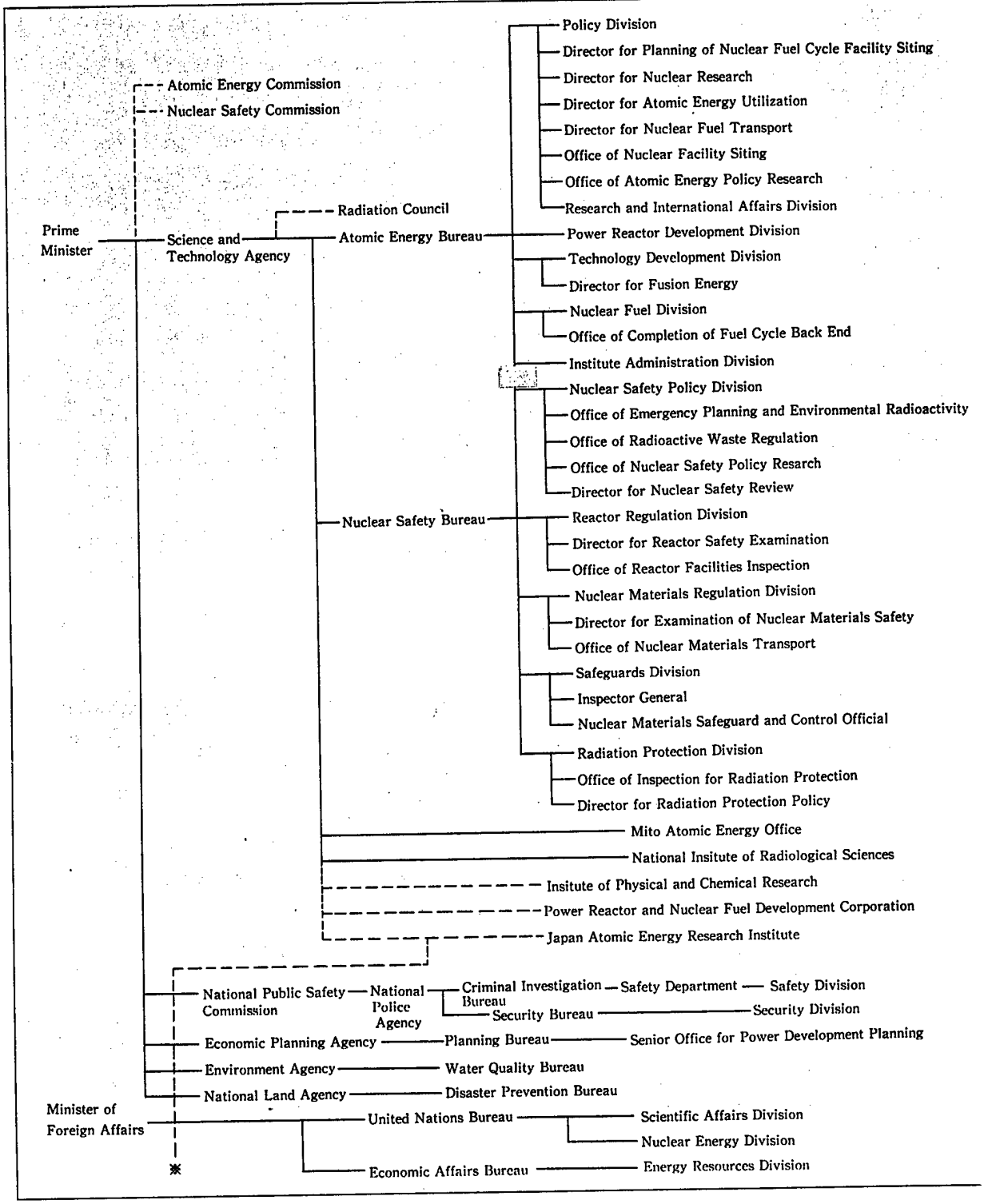
This in turn is overseen by the Atomic Energy Commission (AEC), which was organized to ensure programmatic conformity with government policy and promote democratic management in nuclear energy administration. The AEC formulates a "Long-Term Program for Development and Utilization of Nuclear Energy" about every five years, entailing basic policies for the development and utilization of nuclear energy. And Further, the AEC also formulates an annual Basic Program for Development and Utilization of Nulear Energy as a working plan for achieving the long-term program.

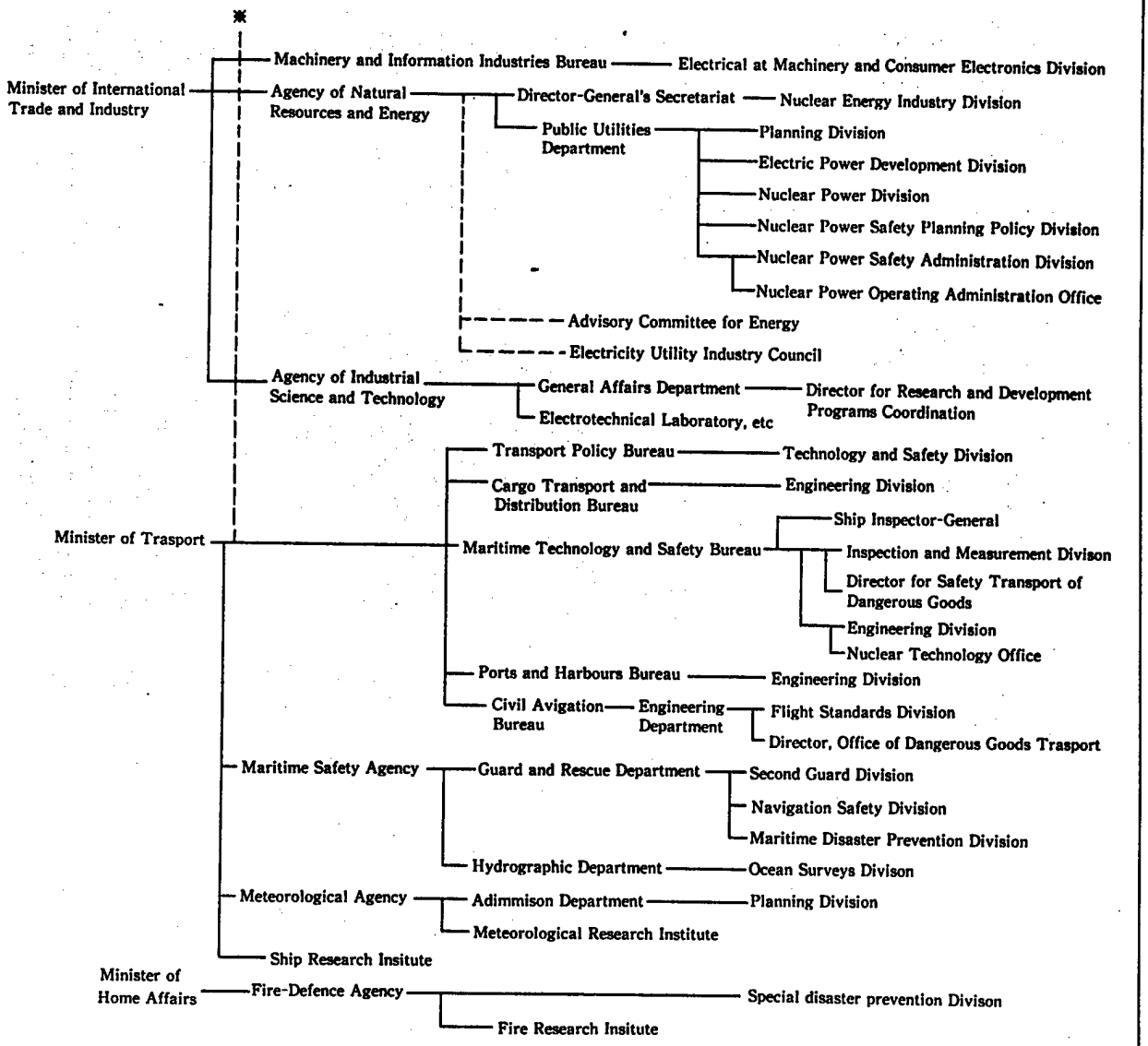
These programs are carried out through the close contact and cooperation of relevant ministries and agencies including the Science and Technology Agency (STA) and the Ministry of International Trade and Industry (MITI), national research institutions including the National Institute of Radiological Sciences (NIRS), government-owned corporations including the Japan Atomic Energy Research Institute (JAERI) and the Power Reactor and Nuclear Fuel Development Corporation (PNC), universities and industry.



Japan AEC Organization

Organization for Development and Utilization




Minister of International Trade and Industry
Machinery and Information Industries Bureau
Electrical at Machinery and Consumer Electronics Division
Agency of Natural Resources and Energy
Director-General's Secretariat
Nuclear Energy Industry Division
Public Utilities Department
Planning Division
Electric Power Development Division
Nuclear Power Division
Nuclear Power Safety Planning Policy Division
Nuclear Power Safety Administration Division
Nuclear Power Operating Administration Office
Advisory Committee for Energy
Electricity Utility Industry Council
Agency of Industrial Science and Technology
General Affairs Department
Director for Research and Development Programs Coordination
Electrotechnical Laboratory, etc
Minister of Trasport
Transport Policy Bureau
Technology and Safety Division
Cargo Transport and Distribution Bureau
Engineering Division
Maritime Technology and Safety Bureau
Ship Inspector-General
Inspection and Measurement Divison
Director for Safety Transport of Dangerous Goods
Engineering Division
Nuclear Technology Office
Ports and Harbours Bureau
Engineering Division
Civil Avigation Bureau
Engineering Department
Flight Standards Division
Director, Office of Dangerous Goods Trasport
Maritime Safety Agency
Guard and Rescue Department
Second Guard Division
Navigation Safety Division
Maritime Disaster Prevention Division
Hydrographic Department
Ocean Surveys Divison
Meteorological Agency
Adimmison Department
Planning Division
Meteorological Research Institute
Ship Research Insitute
Minister of Home Affairs
Fire-Defence Agency
Special disaster prevention Divison
Fire Research Insitute

III. Present Status of the Development and Utilization of Nuclear Energy in Japan

1. Present Status of Nuclear Power Generation in Japan

(1) Trend of nuclear power generation by light-water reactor and other types of reactors

1) Present status of nuclear power generation

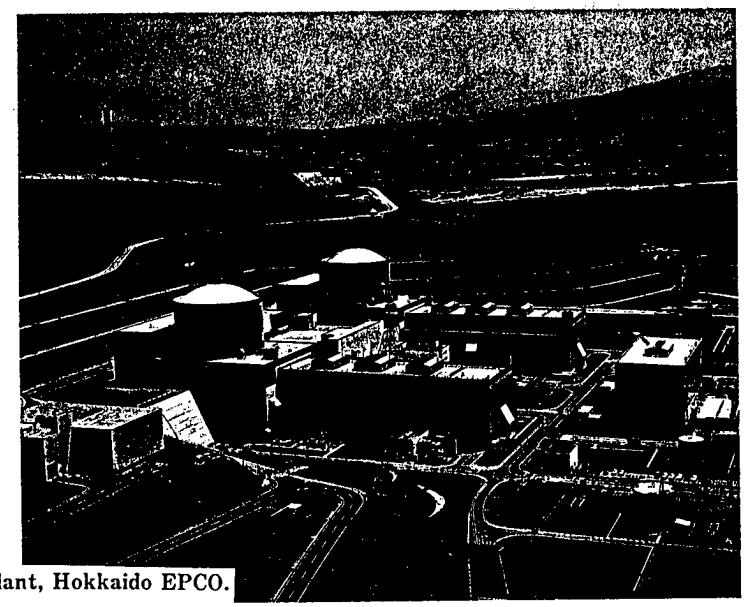
Nuclear power generation in Japan totaled 33,404 MW (42 units including a prototype advanced thermal reactor) as of the end of July 1992. Adding to these in operation, plants under construction or being planned, including those for R&D, and the grand total comes to 55 units or 46,353 MW.

Nuclear power generation capacity as of the end of FY 1990 was 18% of the total power generation capacity (for electric utilities) and 26.6% of the total power generated (ibid) as the actual figure in FY 1990. As such, nuclear power has become firmly rooted as a major source of electricity.

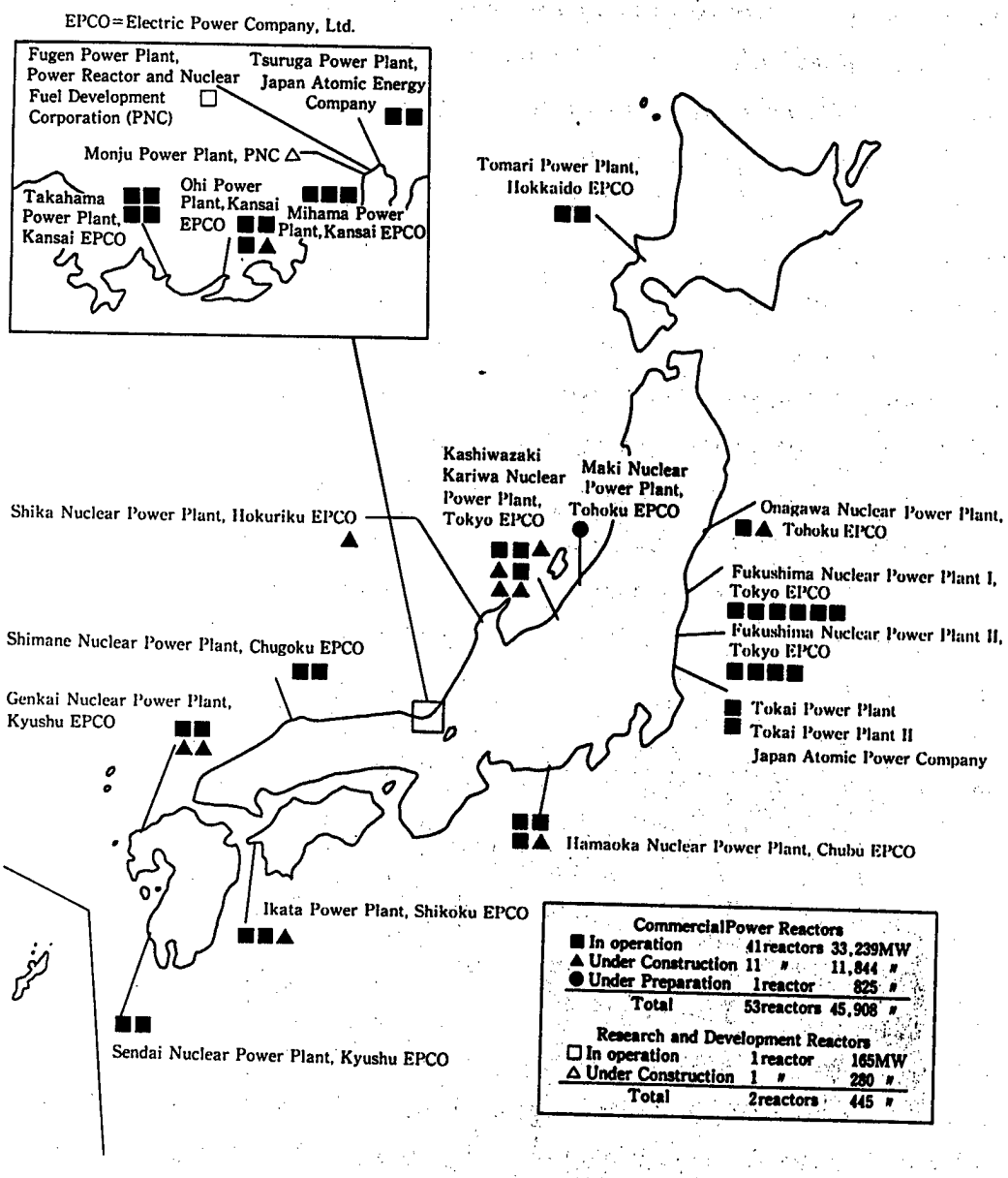
Also, the capacity factor in FY 1990 was 72.7%, and has continuously stood at levels exceeding 70% for the past eight years.

2) Economic performance

According to an estimate by MITI, the cost of electricity is about 9 yen/kWh for nuclear power, 10 yen/kWh for coal-fired and liquefied natural gas (LNG)-fired plants, and 11 yen/kWh for oil-fired plants. Nuclear power is thus more economical than the other power-generating methods.



Tomari Power Plant, Hokkaido EPCO.



Location of Nuclear Power Plants (As of August 1992)

3) Facility siting

The government and electric utilities are making efforts to gain public understanding and cooperation, in order to promote the siting of nuclear power plants. These efforts target community residents by way of various media and an opinion monitoring system on nuclear power.

Also development of proposed sites are encouraged under the provisions of the Electric Power Source Siting Laws.

4) Research and development of light-water reactor (LWR) technology

In Japan, the programs for improvement and standardization of LWR have been carried out in three phases in pursuit of improved reliability, by utilizing Japan's own indigenous technology. In the third phase, an advanced light-water reactor (ALWR) was developed, and Kashiwazaki-Kariha Nuclear Power Station units No. 6 and No. 7 of Tokyo Electric Power Co., Inc. have become the first units which have installed ALWR.

Also, in June 1991, the Subcommittee on Nuclear Energy of the Advisory Committee for Energy concluded a report which pointed out that advanced countermeasures for defects and problems are necessary to enhance safety in the future development of LWR technology.

5) Decommissioning of reactors

As for development of reactor decommissioning technology, the technology will be improved toward the latter half of the 1990's. The JAERI has been working on actual dismantling of the Japan Power Demonstration Reactor (JPDR) since FY 1986, and dismantling of its radiation shielding started from February 1991. Also, the Nuclear Power Engineering Corporation (formerly the Nuclear Power Engineering Test Center) is carrying out verification tests on especially important technologies from the viewpoints of safety and reliability. Moreover, the Research Association for Nuclear Facility Decommissioning is accumulating and disseminating research achievements on the decommissioning of nuclear facilities for R&D.

(2) Establishment of a nuclear fuel cycle

1) Progress in commercial nuclear fuel cycle

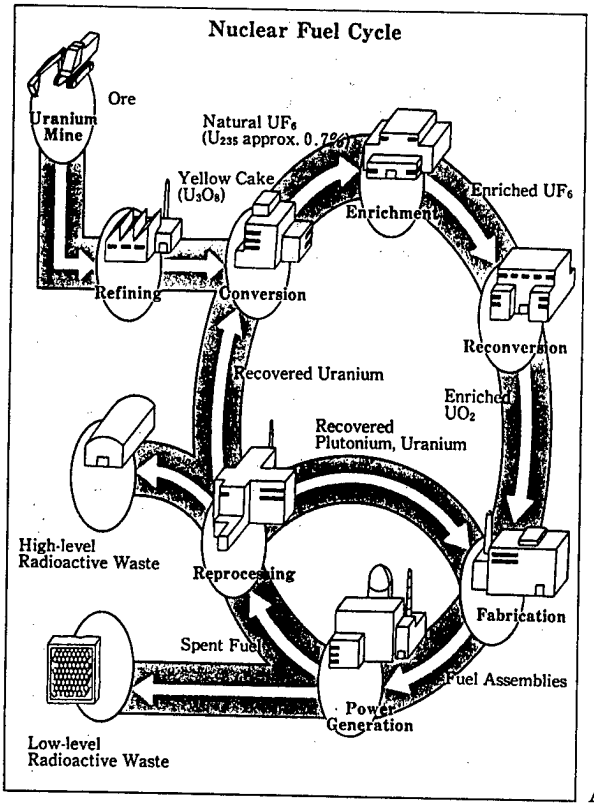
Research and development on the nuclear fuel cycle in Japan has mainly been carried out by the PNC and the JAERI. At the same time, a number of achievements have been obtained by

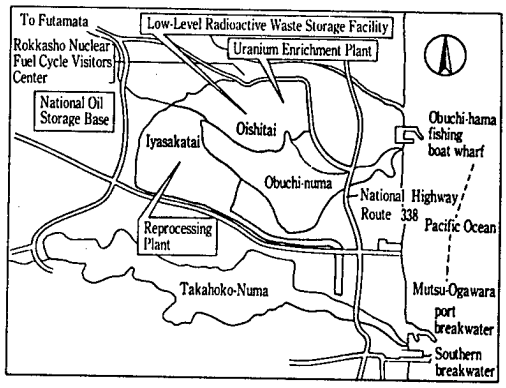
the private sector in reconversion and fabrication of nuclear fuel. In addition, uranium enrichment, reprocessing of LWR spent fuel and low-level radioactive waste disposal are now in the commercialization stage.

The Japan Nuclear Fuel Industries Co., Ltd. (JNFI) (currently Japan Nuclear Fuel Limited (JNFL))* partially started operation of a uranium enrichment plant in March 1992. It also began construction work on a low-level radioactive waste disposal facility after obtaining a license in November 1990.

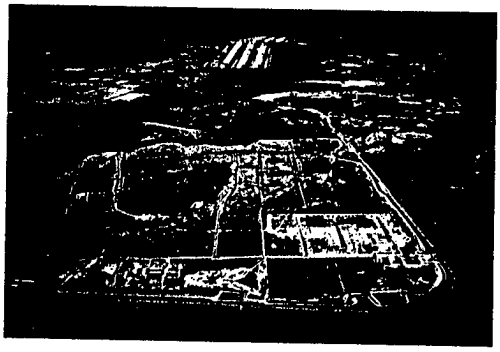
With respect to a reprocessing plant for LWR spent fuel, the project is being planned and promoted by the Japan Nuclear Fuel Services Co. Ltd. (JNFS) (currently JNFL)*, the safety review by the STA has been completed and is now being double-checked by the AEC and the Nuclear Safety Commission (NSC). Also, a license was given in April 1992 for a storage facility for high-level radioactive waste returned from overseas, and construction work started in May 1992.

* Note ; the JNFL was established by the merger of the JNFI and the JNFS in July 1992





Map around Nuclear Fuel Cycle Facilities



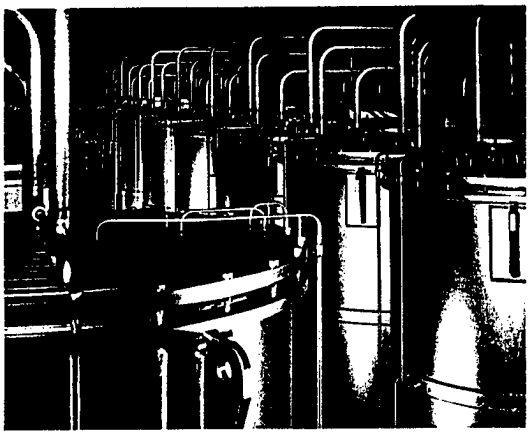
Air Photograph of Nuclear Fuel Cycle Facilities

2) Uranium enrichment

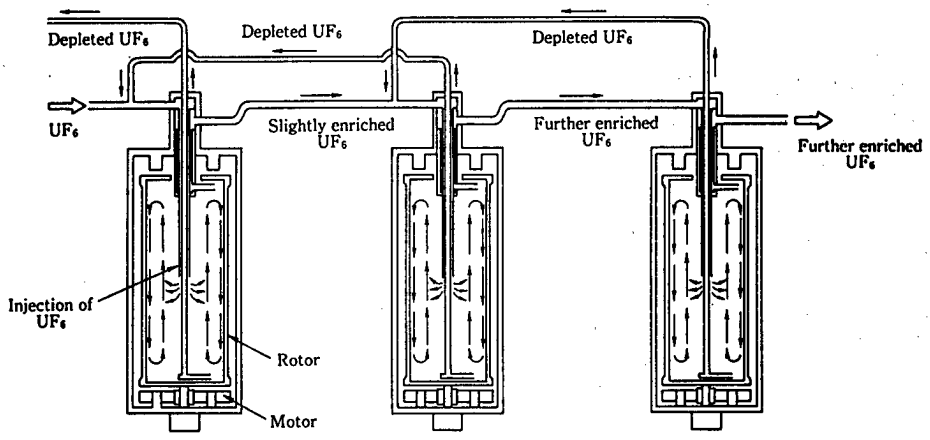
With respect to domestic uranium enrichment, research and development has mainly been promoted by the PNC, which is currently operating a demonstration plant of 200 tons SWU/year. Based on this achievement, the JNFI (currently JNFL) began construction of a commercial enrichment plant in Rokkasho-mura, Aomori Prefecture in October 1988, and started operation of 150 tons SWU/year in March 1992.

The PNC also plans to construct and operate a scale-test facility for high-performance centrifuge research and development using new materials, in cooperation with the private sector.

On the other hand, with regard to new technologies related to uranium enrichment, the JAERI and the Laser Atomic Separation Engineering Research Association of Japan are carrying out



The cascade in the Uranium Enrichment Demonstration Plant



Gas Centrifuge Enrichment

research and development work on atomic vapor laser isotope separation technology, while the PNC and the Institute of Physical and Chemical Research (IPCR) are involved in developing molecular vapor laser isotope separation technology. In addition, a uranium enrichment method with chemical processing has been developed.

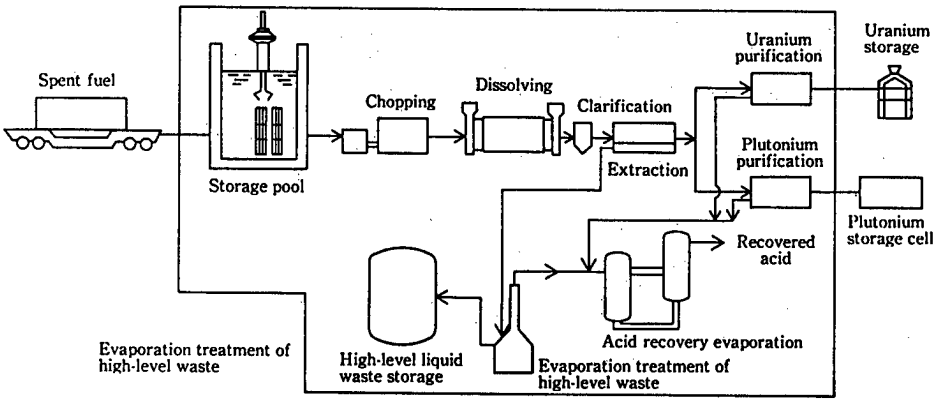
Based on the progress in the research and development work on the new technologies mentioned above, the Special Committee on Uranium Enrichment of the AEC discussed evaluation and review of these new technologies in July 1991. As a result, it was decided to investigate comprehensively a long-term strategy for the development of uranium enrichment.

3) Reprocessing of LWR spent fuel

The Tokai Reprocessing Plant of the PNC began hot tests in September 1977. Operations have continued smoothly with a cumulative amount of 527 tons U of spent fuel reprocessed as of the end of FY 1990.

Spent fuel generated in Japan is also reprocessed in the U.K. and France on a contractual basis. As of the end of FY 1990, about 3,900 tons U of LWR spent fuel had been transported to the two countries, and 1,100 tons U of gas-cooled reactor spent fuel had been sent to the U.K.

The JNFL (former JNFS) has plans to construct a commercial reprocessing plant with a reprocessing capacity of 800 tons U annually, and has scheduled start-up in 1999. With respect to licensing of the commercial facility, the safety review by the STA has already been completed, and a double-check by the AEC and the NSC is now in progress.



Flow of LWR Spent Fuel Reprocessing

4) Radioactive waste treatment and disposal

Low-level radioactive waste

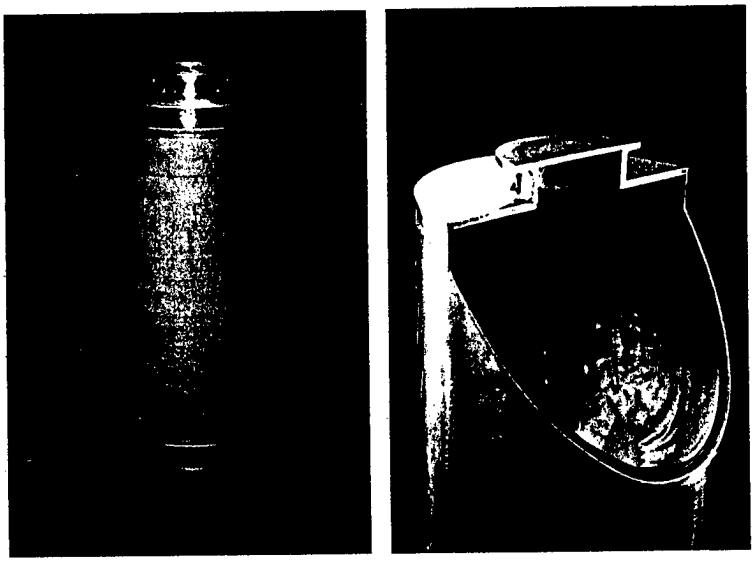
Among the low-level radioactive waste generated in nuclear power plants and other facilities, those in gaseous state and part of those in liquid state are being discharged into the atmosphere or sea water after verifying that release levels are lower than the predetermined levels. Other liquid and solid wastes, after being reduced to a minimum level, are properly treated by proper methods such as incineration, and then stored within each power plant site under safe conditions. As of the end of March 1991, the cumulative volume came to about 780,000 in 200 -liter drum equivalent.

With respect to land disposal of low-level radioactive waste, the JNFI (currently JNFL) is constructing a facility for shallow land disposal of low-level radioactive waste in Rokkasho -mura, Aomori Prefecture, with an operating schedule set for the end of 1992.

High-level radioactive waste

High-level radioactive waste generated up to now by the Tokai Spent Fuel Reprocessing Plant of the PNC has been stored in tanks at the plant under strict control. As of the end of March 1992, the cumulative amount in solution form was about 471 m^3.

The basic process for high-level radioactive waste is vitrification in stainless steel canisters under stable conditions, followed by 30 to 50 years of storage for cooling, and ultimate disposal in underground formation deeper than several hundred meters below ground level.



Vitrified Waste is Encapsulated in Stainless Steel-canisters(left); Cutaway View of a Canister(right

The PNC, which has been playing a central role in research and development of vitrification technology, constructed the Tokai Vitrification Facility (TVF) and started a test run. With respect to geological disposal, the PNC will play a core role in research, development and survey. Thereafter, a demonstration of disposal technology will be conducted at a candidate disposal site selected by the executing body, and the construction and operation of a disposal facility will be started. Moreover, the Storage Engineering Center Project of the PNC in Horonobe-cho, Hokkaido has the objective of realizing an integrated research center aiming at research and development for geological disposal, etc., and measures will be taken to steadily promote the smooth implementation of this project.

In addition, an information exchange plan for an R&D program on nuclide partitioning and transmutation (OMEGA Program) was initiated in June 1989 by the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (NEA/OECD), and three information exchange meetings have been held in Japan and Switzerland.

The AEC also decided in June 1991 on a survey and review by the Advisory Committee on Radioactive Waste Management in pursuit of a review of the entire process of promoting a future high-level radioactive waste policy. In response, the Committee is currently carrying out relevant survey and review.

Others

With respect to radioactive waste containing TRU nuclide generated in the reprocessing of LWR spent fuel and the fabrication of uranium-plutonium mixed-oxide fuel (MOX), appropriate classification and disposal measures corresponding to classification will be established. In accordance with this policy, the Advisory Committee on Radioactive Waste Management of the AEC compiled a report in July 1991 indicating its view on classification of TRU radioactive waste and a procedure for realizing disposal measures.

(3) Prospects of plutonium utilization

For the purposes of realizing more efficient utilization of uranium resources and securing a stable supply of energy in Japan, it is important to establish a utilization system of plutonium which will be obtained from spent fuel reprocessing. The Advisory Committee on Nuclear Fuel Recycling of the AEC concluded reports in December 1989 and August 1991, entitled "A Tentative Method of Plutonium-Returning Transport" and "Nuclear Fuel Recycling in Japan", respectively, suggesting specific actions on nuclear fuel recycling from a long-term viewpoint through the year 2010. The report, "Nuclear Fuel Recycling in Japan", states: "The practical use of fast breeder reactors (FBR) with high efficiency utilization of uranium will be pursued, with plutonium utilization in LWR's as the mainstream for the time being. Also, it is necessary to prepare a system and the technology required for nuclear fuel recycling on a commercial scale. Further, it will also be appropriate to promote plutonium utilization in the advanced thermal reactor (ATR), which is more flexible in fuel use".

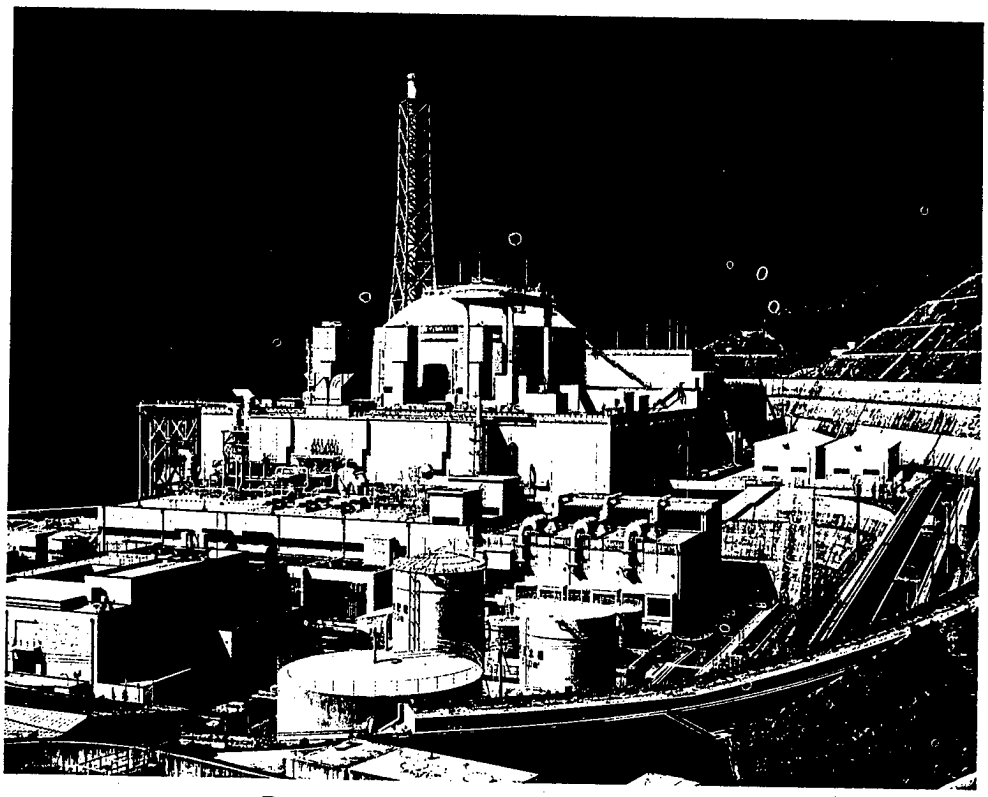
1) Plutonium utilization in light-water reactors and advanced thermal reactors

Plutonium utilization in light-water reactors (Pu thermal) in Japan is mainly being carried out by the electric utility industry, and a small-scale demonstration program on MOX fuel use is being promoted today.

In the development of the ATR, the prototype reactor "Fugen", developed by the PNC, is currently operating smoothly. At present, the Electric Power Development Co., Inc. is making preparations for ATR construction in Ohma-cho, Aomori Prefecture for a scheduled start-up in the year 2001.

2) Fast breeder reactor (FBR)

The PNC has been developing FBR technology, and is constructing the prototype reactor "Monju" in Tsuruga City, Fukui Prefecture, based on the operating experience accumulated through operation of the experimental reactor "Joyo". Monju is now undergoing functional tests and criticality is planned within FY 1992. With respect to the demonstration reactor, a preliminary conceptual design study was completed in March 1992, the main objective of which was to verify the technical feasibility of a Top-Entry loop type reactor; a conceptual design, which allows comprehensive evaluation of the entire plant system, will be made in the future. Also, a "Basic agreement on technical cooperation in research and development for an FBR demonstration reactor" was concluded in March 1989 between the PNC and the Japan Atomic Power Co., Ltd., and cooperation activities are currently being carried out.



Prototype Fast Breader Reactor "MONJU"

3) Reprocessing of FBR spent fuel

The PNC has accumulated basic data with respect to the technology for FBR spent fuel reprocessing. In future research and development, tests in radioactive engineering test facilities will be conducted while maintaining compatibility between the relevant R&D activity and development of the FBR itself, after which a pilot plant could be constructed with start-up scheduled after the year 2000.

4) MOX fuel fabrication

With respect to MOX fuel fabrication, the Atomic Fuel Corporation (currently the PNC) initiated technical development of MOX fuel production in 1966, and development work has been continuing since then. As of the end of March 1991, the cumulative amount of MOX fuel production had reached 107 tons. At present, construction of a fuel production facility for the ATR demonstration reactor (40 tons MOX/year) is planned.

Also, in order to promote domestic commercial operation of MOX fuel fabrication for LWR's, it is necessary to transfer technologies from the PNC to the private sector smoothly. For this purpose, wider utilization of the facilities owned by the PNC must be reviewed as soon as possible. Also, with respect to the plutonium recovered from reprocessing abroad, it will be appropriate to fabricate MOX fuel abroad for a certain period of time; a review in this regard will also be necessary.

5) Plutonium transport

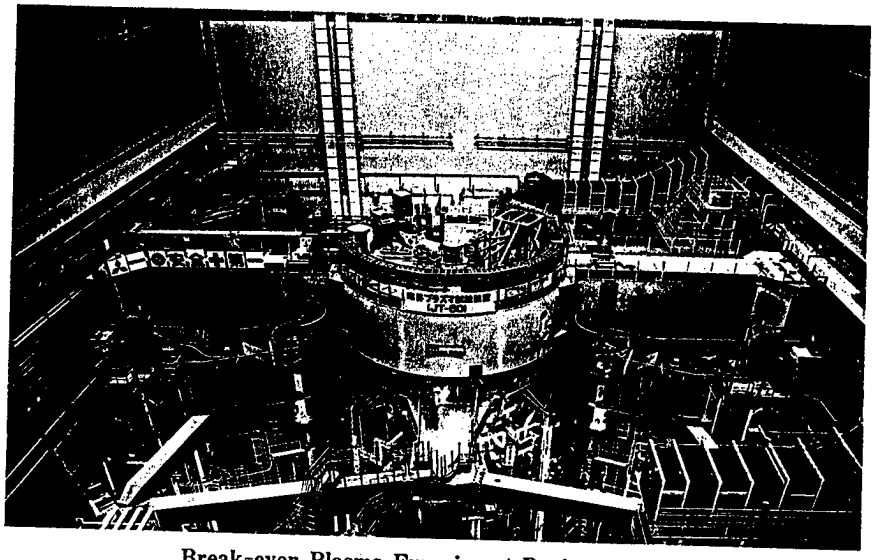
The Advisory Committee on Nuclear Fuel Recycling of the AEC concluded a report recommending international transportation by ship for the time being and also execution of the transportation by the autumn of 1992.

At present, to ensure the smooth execution of shipping transport, the PNC, as the executing body, is preparing a transport plan. The Maritime Safety Agency also built a patrol vessel to safeguard marine transport, thereby making preparations through cooperation with relevant authorities.

2. Promotion of Nuclear Research and Development

(1) Promotion of nuclear fusion research and development

The JAERI, intending to further enhance the plasma performance of the Tokamak type break-even plasma experimental device (JT-60), set out remodeling of the device and rearranging facilities from November 1989 to up-grade and promote deuterium use, and began experiments (II) on achieving higher performance in March 1991. Also, research and development for reactor engineering technology has been conducted, and a design review of a new large-scale device is being carried out.



Break-even Plasma Experiment Device "JT-60"

The National Institute for Fusion Sciences is also promoting the production of a Large Helical Device, and several universities are conducting pioneering and basic researches using various plasma confinement methods as well.

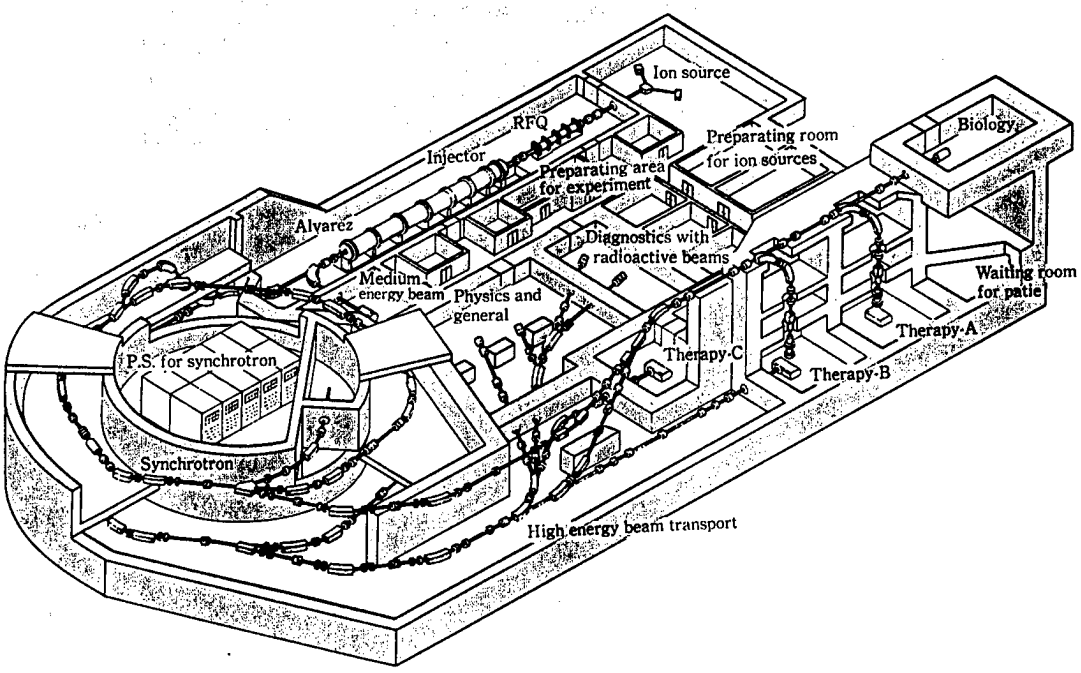
In addition, the JAERI is actively carrying out international cooperation in nuclear fusion, such as in the design activities of the International Thermonuclear Experimental Reactor (ITER), which involves Japan, the U.S., the EC and the former U.S.S.R.

On the other hand, cold fusion research was announced and reproductions of the phenomenon have and are being attempted in many countries. But it lacks reproducibility and is sporadic. Thus, whether this is really a nuclear fusion reaction or not has not yet been recognized. However, retesting for clarification and demonstration of the cold fusion phenomenon is being carried out continuously.

(2) Present status of radiation application

Radiation is being applied for diagnosis and treatment in the medical field. In the case of diagnosis, it is widely utilized in radiography and X-ray computed tomography (X-ray CT). Positron CT has also been put to practical use, and further enhancement of diagnostic technology through applications of radiation and radioisotopes is expected as well. With respect to treatment, cancer treatment using X-rays, γ-rays and electron-beams have been put to practical use. Moreover, research and development into practical cancer treatment using fast neutron beams, proton beams and heavy ion beams are being pursued as well.

In the areas of agriculture, forestry, and fisheries, radiation is being used for quality improvement, pest control, and food irradiation. It has particularly been employed in the comprehensive pest control campaign against melon flies by the release of sterilized insects. The project has been so successful through the entire area of the Amami Islands, Kume Island and the Miyako Islands that shipping restrictions on vegetables and fruits have been removed. Also, complete eradication of the melon fly was verified in October 1990 on the main island of Okinawa and adjacent islands.



Bird's-eye-view of HEAVY ION MEDICAL ACCELERATOR

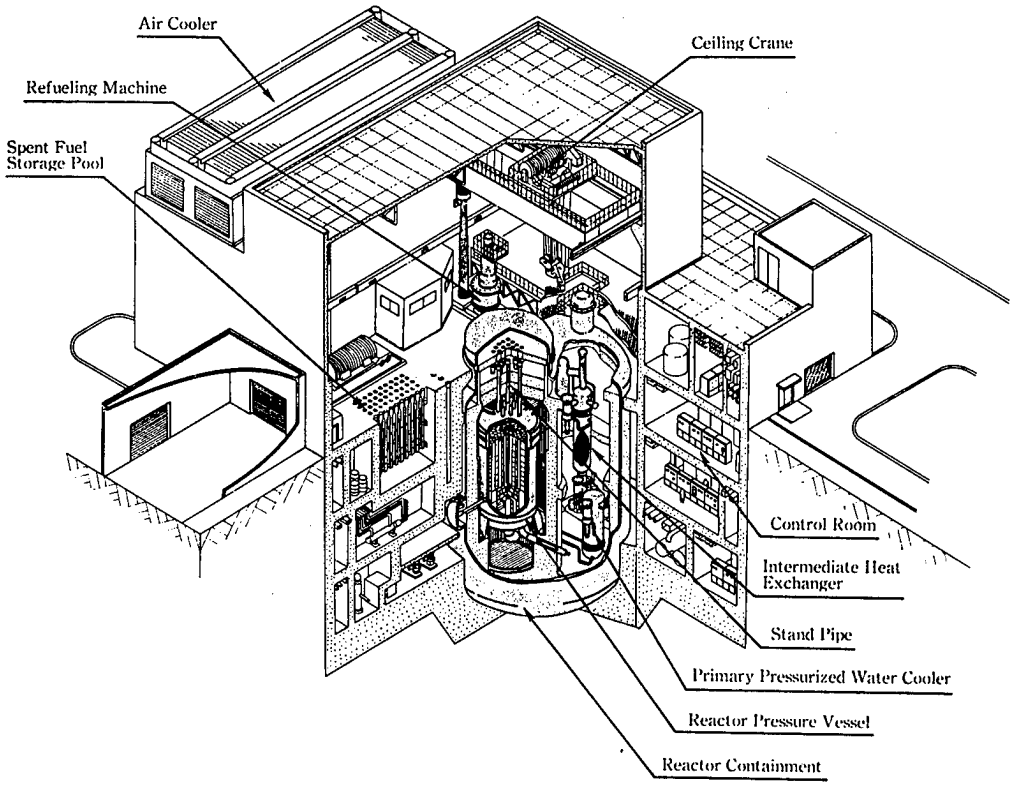
In the industrial area, radiation is being used for accurate measurement of product thickness, nondestructive testing and modification of various high-polymer materials.

With respect to research and development on accelerator beam techniques, the JAERI is building ion irradiation research facilities, and the JAERI and the IPCR are jointly constructing a large-scale synchrotron radiation facility (SPring-8). The NIRS is also now building a Heavy Ion Medical Accelerator in Chiba (HIMAC).

Also, environmental conservation technology such as excess sludge treatment and exhaust gas desulfurizers and denitrifiers using radiation is being studied and developed.

(3) High temperature engineering testing and research

At the JAERI, construction of the High-Temperature Engineering Test Reactor (HTTR) was started in March 1991. Also, various research and development on high temperature gas-cooled reactor technology is being performed. In addition, research and development for hydrogen production is being conducted towards the utilization of high temperature gas from the HTTR.

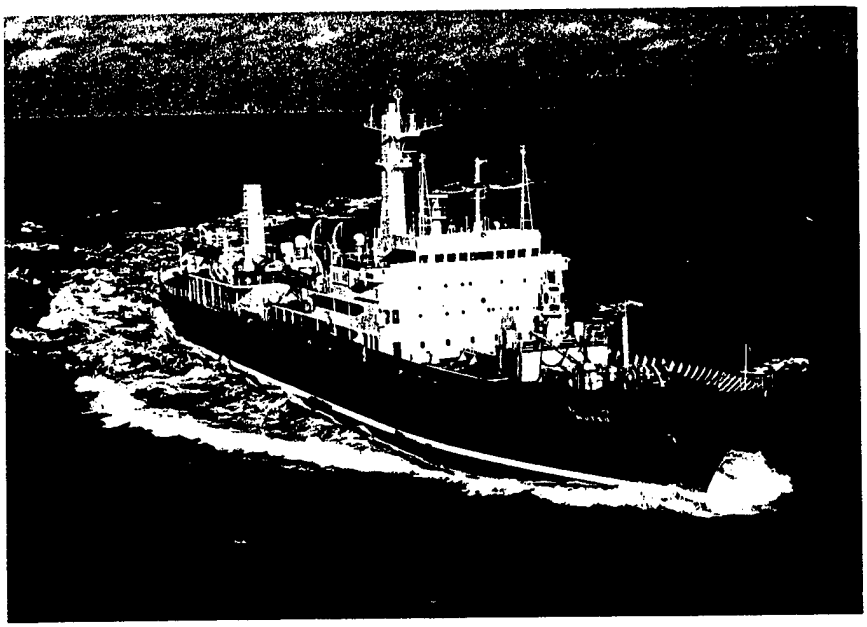


Bird's-eye-view of HTTR Reactor Building

(4) Nuclear ship

The JAERI's nuclear ship "Mutsu" has completed four experimental cruises since 1991, the purposes of which were to obtain knowledge related to the influence of vibration, oscillation and load fluctuation on a nuclear reactor under a marine environment. In the future, the Mutsu is scheduled to be decommissioned at Sekinehama Port.

Experimental data and knowledge obtained through the experiments will be utilized in research on the development of reactors for ships in the future.



Nuclear Ship "Mutsu"

(5) Basic researches and underlying technology development

The JAERI, universities, and national research organizations are conducting basic researches in many areas including reactor and nuclear physics, physiological studies on radiation, irradiation tests on fuels and materials, and studies on the movement of radioactive materials in the environment and ecosystem.

Underlying technology of nuclear research pursuing construction of the nuclear technology systems to be required in the 21st century has been carried out since FY 1988 in four major

areas: nuclear material, artificial intelligence, laser technology, and technology for radiation risk analysis and risk reduction. Research activities in these areas are being performed by the JAERI, the PNC, the IPCR, and other national research organizations.

Among these, themes, that can be more efficiently and effectively promoted through cooperation among several research organizations, have been pursued since fiscal 1989 under a "comprehensive research program for nuclear basic technology development" involving tie-ups and cooperation between relevant organizations. Moreover, research and development through exchanges among organizations is actively being promoted including the building-up of a common database on material development for nuclear power.

In addition, the Nuclear Power Engineering Research Liaison Committee of the Science Council of Japan compiled a report entitled "Social Requests for Education on Nuclear Power Engineering and Future Research Themes" in June 1991, with respect to basic research and human resource training.

It proposed the establishment of an education and research cooperation structure domestically and worldwide through such as: (a) promotion of research based on a priority system, and (b) structual arrangement for education and research such as promotion of utilization of nuclear facilities outside universities.

(6) Research on new types of reactors

With respect to new types of nuclear reactors such as high-conversion LWR's, small or medium-sized inherently safe reactors, and modular type liquid metal reactors, basic and fundamental research is being carried out step by step over a broad range in order to review the possibility of a breakthrough in nuclear reactor technology in the future.

3. Active Contribution Toward the International Society

(1) Promotion of international cooperation

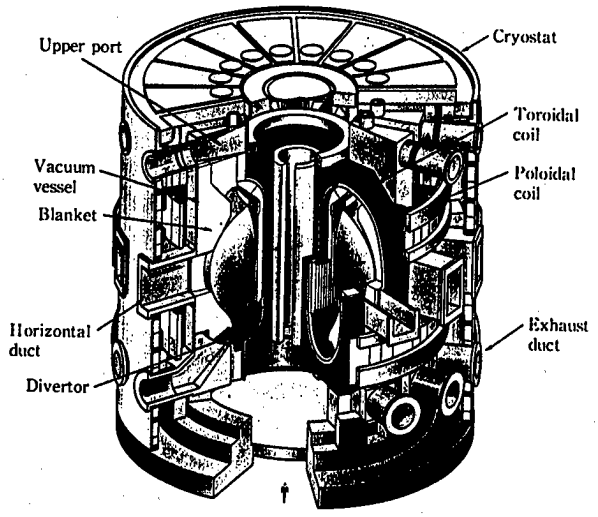
1) Cooperation with advanced countries in the nuclear field

The JAERI, the PNC and other organizations have aggressively carried out bilateral cooperation with advanced countries in the nuclear field, including the U.S., Germany, France and the U.K., through information exchange, interchange of specialists, and research cooperation in diversified areas such as light-water reactors, fast breeder reactors and reprocessing. Also, in April 1991, the Japan-U.S.S.R. Nuclear Power Cooperation Agreement and Memorandum on Cooperation Related to the Accident at the Chernobyl Nuclear Power Plant were concluded. At the same time, Japan is involved in multilateral cooperation at the governmental level based on agreements and through international organizations in addition to bilateral activities. Areas of cooperation include safety at nuclear power plants, development of a fast breeder reactor, and research and development for high-technology areas in nuclear power. One such international cooperative effort was the already-mentioned Conceptual Design Activities (CDA) of the ITER, involving Japan, the U.S., the EC and the former U.S.S.R., which was started in April 1988 and completed in December 1990 under the auspieces of the IAEA. With respect to the Engineering Design Activities (EDA) of the ITER for the next stage, discussions among the four participants were held from February 1991 and an agreement was reached at the third meeting in July 1991 on the sites for joint design work at the three places of Naka-machi, Ibaraki Prefecture, Japan (Naka Research Establishment, JAERI), San Diego, California, U.S.A., and Garching, Germany, EC. At the fourth meeting, which was held in Moscow in November 1991, the four parties initialled the text of the Agreement for ITER/EDA and agreed to proceed with the review by each parties' authorities. In July 1992, the agreement for ITER/EDA was signed by the four parties and EDA are expected to start smoothly.

With respect to nuclide partitioning and transmutation technology for high-level radioactive waste, Japan has initiated the OMEGA Program, an international cooperation program utilizing information exchange, through the NEA/OECD. The first information exchange meeting was held in Japan in November 1990.

As for international cooperation in the private sector, the World Association for Nuclear Operators (WANO) was founded in 1989 to exchange information among electric utilities. The

Asia Regional Center (Tokyo Center) of WANO was founded in April 1989, and mutual visits to nuclear power plants are currently being carried out between regional centers.



ITER (International Thermonuclear Experimental Reactor)

2) Cooperation with developing countries

Japan is presently undertaking cooperative activities including expert exchanges and joint researches with Indonesia, Malaysia, Thailand, Korea, China, and other countries in the areas of research reactors, radiation application, safety, waste treatment and disposal, and uranium ore exploration technology.

Also, in 1978, Japan signed the "Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA)," executed under the auspices of the IAEA, and is aggressively and widely cooperating within the Asian and Pacific areas. Moreover, the AEC has been sponsoring the International Conference for Nuclear Cooperation in Asia since March 1990, in pursuit of mutual exchange of information on the present status of development and utilization of nuclear technology in neighboring Asian countries, and also to exchange opinions on the best course for regional cooperation. The third international conference was held in March 1992.

(2) Strengthening the nuclear non-proliferation regime and the role of Japan

1) Recent trends in nuclear non-proliferation

With respect to nuclear non-proliferation, a new world order is now being formed as a result

of the collapse of the
U.S.S.R., and the world is now concerned about the control of nuclear materials arising from the nuclear arsenal and the outflow of technologies and experts related to nuclear arms. Also, after the Gulf War, it was discovered that Iraq possessed nuclear materials undeclared to the IAEA, so that this body is now reviewing arrangements and strengthening its safeguards system. In North Korea, for example, a full-range safeguards agreement was effected on April 10, 1992, and total compliance is now required.

2) Safeguards

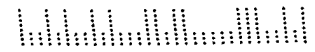
Today, the world is concerned over the problem of worldwide nuclear proliferation. Japan has promoted the development and utilization of nuclear power strictly for peaceful purposes in accordance with its Atomic Energy Basic Law and will more aggressively strengthen the nuclear non-proliferation regime under close coordination with other countries. For this purpose, Japan will continuously and aggressively contribute to the maintenance and strengthening of IAEA safeguards.

3) Nuclear materials protection

Japan partially amended the "Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors," arranged a domestic regime, and signed a treaty on nuclear material protection in October 1988. The treaty became effective for Japan in November 1988.

In addition, the treaty prescribes clarification of a responsible central organization and liaison organization for each country. Therefore, in January 1991, Japan notified the IAEA of the registration of the STA as the central organization and the Ministry of Foreign Affairs as liaison organization.

- END -



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